C L A I M S

1. A circularly polarized antenna characterized by comprising:

a dielectric substrate;

a ground conductor which is piled up one surface side of the dielectric substrate;

a circularly polarized type of antenna element formed on an opposite surface of the dielectric substrate;

a plurality of metal posts whose respective one end sides are connected to the ground conductor and penetrate the dielectric substrate along a thickness direction thereof, and whose respective other end sides extend up to the opposite surface of the dielectric substrate, the plurality of metal posts configuring a cavity by being provided at predetermined intervals so as to surround the antenna element; and

a conducting rim which short-circuits the respective other end sides of the plurality of metal posts along an array direction thereof, and is provided so as to extend by a predetermined distance in a direction of the antenna element at the side of the opposite surface of the dielectric substrate.

2. The circularly polarized antenna according to claim 1, characterized in that

the antenna element has a predetermined polarization rotation direction, and is formed of a

square-shaped spiral type or a circular spiral type having a central side end portion of a spiral, and

the circularly polarized antenna further comprises a feed pin whose one end side is connected to the central side end portion of the spiral of the antenna element formed of the square-shaped spiral type or circular spiral type, the feed pin being provided so as to penetrate the dielectric substrate and the ground conductor.

3. The circularly polarized antenna according to claim 2, characterized in that

the antenna element which is formed on the dielectric substrate and the feed pin whose one end side is connected to the central side end portion of the spiral of the antenna element are provided to be respectively in plural sets,

the predetermined polarization rotation directions of the plural sets of antenna elements are respectively formed so as to be identical polarization rotation direction,

the plurality of metal posts configuring the cavities and the conducting rim are formed in a lattice shape so as to surround the plural sets of antenna elements of, and

the circularly polarized antenna further comprises a feed unit to distribute and supply excitation signals to the plural sets of antenna elements via the plural

sets of feed pins, the feed unit being provided at a side of the ground conductor.

4. The circularly polarized antenna according to claim 3, characterized in that the feed unit is configured by a feeding dielectric substrate provided at a side opposite to the dielectric substrate so as to sandwich the ground conductor, and a microstrip type of feeding line formed on a surface of the feeding dielectric substrate.

5. The circularly polarized antenna according to claim 3, characterized in that

the plural sets of antenna elements are formed so as to have at least two types of different array angles of identical array angle and different array angles from one another respectively around axes perpendicular to the opposite surface of the dielectric substrate, and

among the plural sets of antenna elements, the feed unit distributes and supplies the excitation signals among the respective antenna elements having the identical array angle in-phase, and distributes and supplies the excitation signals among the respective antenna elements having the different array angles such that respective main polarization components are in-phase and respective cross polarization components are out of phase.

6. The circularly polarized antenna according to

claim 2, characterized in that the antenna element formed of the square-shaped spiral type is formed as a square-shaped spiral type of antenna element with a predetermined number of turns which are interlinked with one another in a square-shaped spiral form configured such that, assuming that a basic length is a0 with a predetermined element width W, lines having lengths of the a0 and integer multiples of the a0 are arranged at each angle of 90°.

7. The circularly polarized antenna according to claim 2, characterized in that the antenna element formed of the circular spiral type is formed as a circular spiral type of antenna element having a predetermined number of turns which are interlinked with one another in a circular spiral form with a predetermined element width W at a predetermined spiral interval d, and with a predetermined radius initial value SR from a reference point.

8. The circularly polarized antenna according to claim 1, characterized in that

as the antenna element, first circularly polarized type of antenna elements having a predetermined polarization rotation direction, and second circularly polarized type of antenna elements having a polarization rotation direction in a direction opposite to the predetermined polarization rotation direction are formed on the dielectric substrate,

the plurality of metal posts, whose respective one end sides are connected to the ground conductor and penetrate the dielectric substrate along a thickness direction thereof, and whose respective other end sides extend up to the opposite surfaces of the dielectric substrate, respectively configure isolated cavities by being provided at predetermined intervals so as to surround the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements in isolation, and

as the conducting rim, a first conducting rim and a second conducting rim, which respectively short-circuit the respective other end sides of the plurality of metal posts which are respectively provided at predetermined intervals so as to surround the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements in isolation along array directions thereof, are provided on the opposite surface side of the dielectric substrate so as to extend by a predetermined distance in directions of the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements.

9. The circularly polarized antenna according to claim 8, characterized in that one of the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements is

applied as a transmitting antenna of a radar device, and another of the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements is applied as a receiving antenna of the radar device.

10. The circularly polarized antenna according to any one of claims 1 to 9, characterized in that a resonator is configured by the cavities and the conducting rims, and structural parameters of the resonator and the antenna elements are adjusted to set a resonant frequency of the resonator to a desired value, whereby a frequency characteristic is obtained in which a gain of the circularly polarized antenna declines within a predetermined range.

11. The circularly polarized antenna according to claim 10, characterized in that the structural parameters include at least one of an inside dimension Lw of the cavity, a rim width L_R of the conducting rim, the number of turns of the antenna element, a basic length a0 of the antenna element, and a line width W of the antenna element.

12. A radar device characterized by comprising:

a transmitting unit which radiates a radar pulse into a space via a transmitting antenna;

a receiving unit which receives via a receiving antenna a reflected wave of the radar pulse returned from the space;

an analysis processing unit which explores an object existing in the space based on a reception output from the receiving unit; and

a control unit which controls at least one of the transmitting unit and the receiving unit based on an output from the analysis processing unit, wherein

the receiving antenna and the transmitting antenna are configured by first circularly polarized type of antenna elements having a predetermined polarization rotation direction and second circularly polarized type of antenna elements having a polarization rotation direction in a direction opposite to the predetermined polarization rotation direction, the first and second circularly polarized type of antenna elements each comprising:

a dielectric substrate;

a ground conductor which is piled up one surface side of the dielectric substrate;

a circularly polarized type of antenna element formed onto an opposite side of the dielectric substrate;

a plurality of metal posts whose respective one end sides are connected to the ground conductor and penetrate the dielectric substrate along a thickness direction thereof, and whose respective other end sides extend up to the opposite surface of the dielectric substrate, the plurality of metal posts configuring

cavities by being provided at predetermined intervals so as to surround the antenna element; and

a conducting rim which short-circuits the respective other end sides of the plurality of metal posts along array directions thereof, and is provided so as to extend by a predetermined distance in the direction of the antenna element at the opposite surface side of the dielectric substrate,

the plurality of metal posts, whose respective one end sides are connected to the ground conductor and penetrate the dielectric substrate along a thickness direction thereof, and whose respective other end sides extend up to the opposite surface of the dielectric substrate, respectively configure isolated cavities by being provided at predetermined intervals so as to surround the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements in isolation, and

as the conducting rim, a first conducting rim and a second conducting rim, which short-circuit the respective other end sides of the plurality of metal posts which are respectively provided at predetermined intervals so as to surround the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements in isolation along array directions thereof, are provided on the opposite surface side of the dielectric

substrate so as to extend by a predetermined distance in the directions of the first circularly polarized type of antenna elements and the second circularly polarized type of antenna elements.

13. The radar device according to claim 12, characterized in that

the antenna element has a predetermined polarization rotation direction, and is formed of a square-shaped spiral type or a circular spiral type having a central side end portion of a spiral, and

the radar device further comprises a feed pin whose one end side is connected to the central side end portion of the spiral of the antenna element formed of the square-shaped spiral type or circular spiral type, the feed pin being provided so as to penetrate the dielectric substrate and the ground conductor.

14. The radar device according to claim 13, characterized in that

the antenna element which is formed on the dielectric substrate and the feed pin whose one end side is connected to the central side end portion of the spiral of the antenna element are provided to be respectively in plural sets,

the predetermined polarization rotation directions of the plural sets of antenna elements are respectively formed so as to be identical polarization rotation direction,

the plurality of metal posts configuring the cavities and the conducting rim are formed in a lattice shape so as to surround the plural sets of antenna elements, and

the radar device further comprises a feed unit to distribute and supply excitation signals to the plural sets of antenna elements via the plural sets of feed pins, the feed unit being provided at a side of the ground conductor.

15. The radar device according to claim 14, characterized in that the feed unit is configured by a feeding dielectric substrate provided at a side opposite to the dielectric substrate so as to sandwich the ground conductor, and a microstrip type of feeding line formed on a surface of the feeding dielectric substrate.

16. The radar device according to claim 14, characterized in that

the plural sets of antenna elements are formed so as to have at least two types of different array angles of identical array angle and different array angles from one another respectively around axes perpendicular to the opposite surface of the dielectric substrate, and

among the plural sets of antenna elements, the feed unit distributes and supplies the excitation signals among the respective antenna elements having

the identical array angle in-phase, and distributes and supplies the excitation signals among the respective antenna elements having the different array angles such that respective main polarization components are in-phase and respective cross polarization components are out of phase.

17. The radar device according to claim 13, characterized in that the antenna element formed of the square-shaped spiral type is formed as a square-shaped spiral type of antenna element with a predetermined number of turns which are interlinked with one another in a square-shaped spiral form configured such that, assuming that a basic length is a0 with a predetermined element width W, lines having lengths of the a0 and integer multiples of the a0 are arranged at each angle of 90°.

18. The radar device according to claim 13, characterized in that the antenna element which is formed of the circular spiral type is formed as a circular spiral type of antenna element having a predetermined number of turns which are interlinked with one another in a circular spiral form with a predetermined element width W at a predetermined spiral interval d, and with a predetermined radius initial value SR from a reference point.

19. The radar device according to any one of claims 12 to 18, characterized in that a resonator is

configured by the cavities and the conducting rims, and structural parameters of the resonator and the antenna elements are adjusted to set a resonant frequency of the resonator to a desired value, whereby a frequency characteristic is obtained in which a gain of the circularly polarized antenna declines within a predetermined range.

20. The radar device according to claim 19, characterized in that the structural parameters include at least one of an inside dimension Lw of the cavity, a rim width L_R of the conducting rim, the number of turns of the antenna element, a basic length a0 of the antenna element, and a line width W of the antenna element.